body 2, the balls of the bearing assembly 4 enter into the ball-shaped grooves 10 in the upper or lower race and are locked therein. Fig. 7B shows a self-tightening state of the balls of the bearing assembly 4 in which the balls are in the ball-shaped grooves. Thus, the percussive vibrations transmitted through the body 2 of the chuck are unlikely to overcome the difference between the high and low energy states of the balls of the bearing assembly 4, the low energy state corresponding to the location of the balls in the ball-shaped grooves. Depending upon the specific application of the chuck and the expected impact loads during operation, the choice of having ball-shaped grooves in either or both of the race surfaces of the nut 5 and the bearing ring 3 and the number and depth of the ball-shaped grooves can be optimized.

Fig. 6 is an axial, longitudinal sectional view of a self-tightening chuck according to another embodiment of the present invention, wherein the chuck comprises a rear sleeve 1, a body 2, an upper bearing ring 31, a bearing assembly 4, a lower bearing ring 32, a nut 5, a jaw 6, a front sleeve 7 and a stopper 8. In this embodiment, the lower bearing ring 32 is used as the other race of the balls of the bearing assembly 4 in place of the nut 5 in the previous embodiment. The upper bearing ring 31 and the lower bearing ring 32 may have the same external dimensions. The surface of at least one of the upper and lower bearing rings that faces the bearing assembly 4 is provided with a recessed circumferential arcuate race 9, and a plurality of ball-shape grooves 10 are uniformly formed in an arcuate bottom surface of the arcuate race 9. The chuck in this embodiment operates according to the same working principle as that in the previous embodiment, and hence a detailed description thereof is omitted.

During assembly, the metal front sleeve 7 engages, through press-fit, with the nut 5 that is placed in a circular groove in the body 2 and split into two halves by split notches 11. Thanks to the strength and the elastic/plastic deformability of the metal material per se, the metal front sleeve 7 is securely connected to the nut 5 through press-fit, thus ensuring transmission of an input torque. Before press-fit, the metal sleeve 7 is surface-treated by electrophoresis painting, static plastic spraying or anodized processing so that its surface meets different requirements in color.

What is claimed is:

1. A self-tightening keyless chuck for gripping a tool shank, comprising:

a rear sleeve (1);
a body (2);
a bearing ring (3);
a bearing assembly (4);
a nut (5);
a jaw (6);
a front sleeve (7); and
a stopper (8),

wherein the surface of at least one of the bearing ring (3) and the nut (5) that faces the bearing assembly (4) is provided with a recessed circumferential arcuate race (9), and a plurality of ball-shape grooves (10) are uniformly formed in an arcuate bottom surface of the arcuate race (9),
and wherein the front sleeve (7) engages with the nut (5) through radial smooth press-fit.

2. The self-tightening keyless chuck according to claim 1, wherein the nut (5) is provided with two angularly-cut split notches (11) that are symmetrically positioned on both ends of a diameter of the nut, the angularly-cut split notches (11) having a cut-out angle between 30 and 75° .

3. A self-tightening keyless chuck for gripping a tool shank, comprising:

a rear sleeve (1);
a body (2);
an upper bearing ring (31);
a bearing assembly (4);
a lower bearing ring (32);
a nut (5);
a jaw (6);
a front sleeve (7); and
a stopper (8),

wherein the surface of at least one of the upper bearing ring (31) and the lower bearing ring (32) that faces the bearing assembly (4) is provided with a recessed circumferential arcuate race (9), and a plurality of ball-shape grooves (10) are uniformly formed in an arcuate bottom surface of the arcuate race (9),
and wherein the front sleeve (7) engages with the nut (5) through radial smooth press-fit.

4. The self-tightening keyless chuck according to claim 3, wherein the nut (5) is provided with two angularly-cut split notches (11) that are symmetrically positioned on both ends of a diameter of the nut, the angularly-cut split notches (11) having a cut-out angle between 30 and 75° ,
and wherein two parallel cut-out surfaces (13) are symmetrically formed on the outer peripheral surface of the nut (5), which extend downwards in an axial direction from the front end surface of the nut (5) by one third of the thickness of the nut and are located at an angle of 90° relative to the positions of angularly-cut split notches (11).

5. The self-tightening keyless chuck according to claim 1 or 3, wherein the front sleeve (7) is press cast using a press-casting metal or a powdered metallurgic material.

6. The self-tightening keyless chuck according to claim 1 or 3, wherein the recessed circumferential arcuate race (9) has an arc radius R from 1.5 to 2.5 millimeters and a depth H from 0.05 to 0.30 millimeters.

7. The self-tightening keyless chuck according to claim 1 or 3, wherein the number of ball-shaped grooves (10) ranges from 20 to 80.

8. The self-tightening keyless chuck according to claim 1 or 3, wherein the ball-shaped grooves (10) have a spherical radius r from 1.0 to 2.0 millimeters and a depth h from 0.01 to 0.10 millimeters.

9. The self-tightening keyless chuck according to claim 3, wherein the upper bearing ring (31) and the lower bearing ring (32) have the same external dimensions and the same surface structure.

10. The self-tightening keyless chuck according to claim 3, wherein the upper bearing ring (31) and the lower bearing ring (32) have different external dimensions and different surface structures, their differences including the inside diameter and the thickness of the bearing rings.